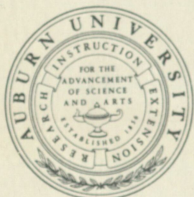


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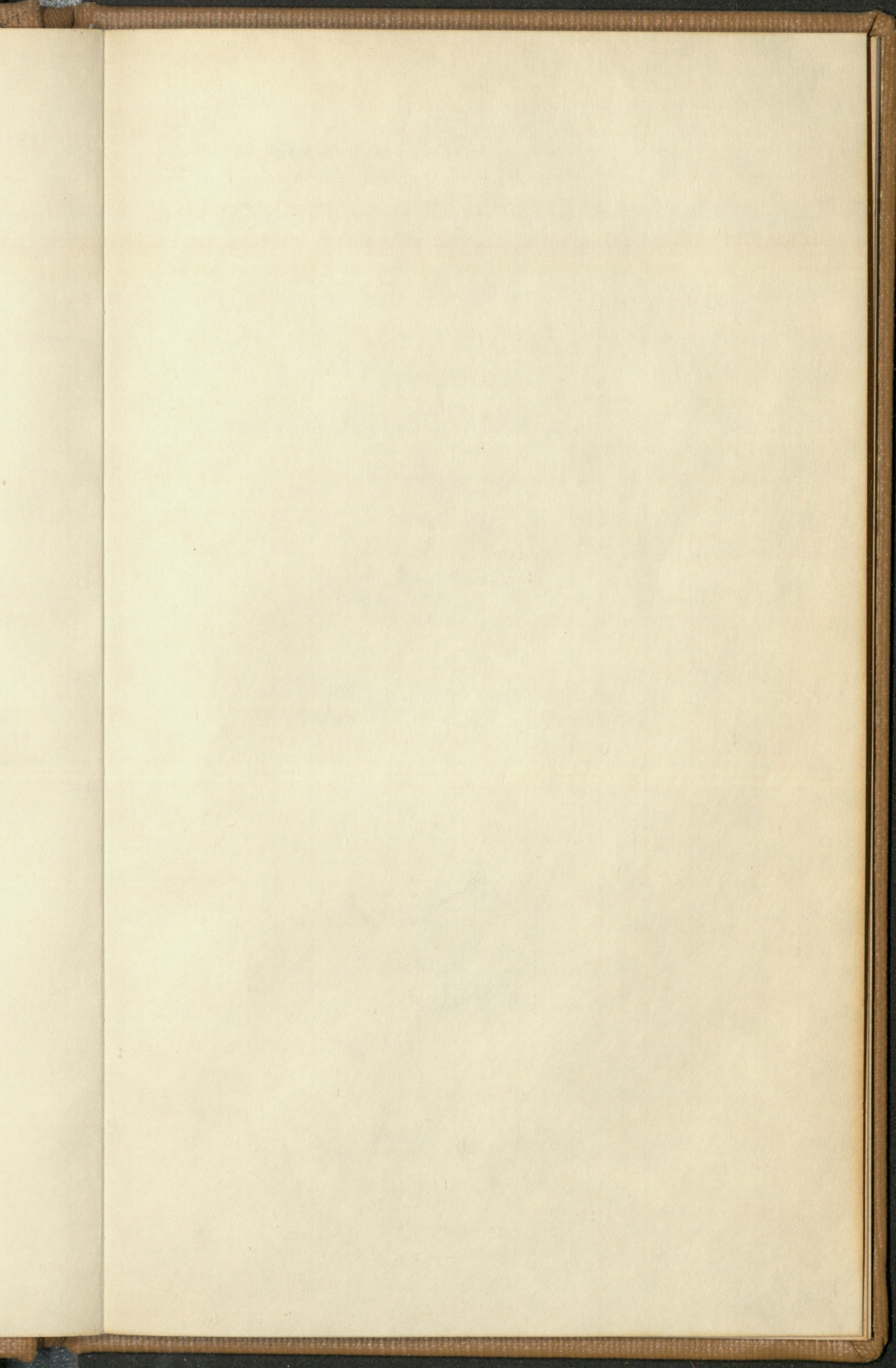
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GEOLOGICAL SURVEY OF ALABAMA

Walter B. Jones, State Geologist (on leave)

Bulletin 51

KNOW ALABAMA!

The Geology and Mineral Resources of Alabama

A Bibliography for Schools

By

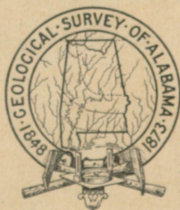
ELLEN HILDRETH

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UNIVERSITY, ALABAMA

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LETTER OF TRANSMITTAL

University, Alabama

August 12, 1942

Honorable Frank M. Dixon,
Governor of Alabama,
Montgomery, Alabama.

Sir:

I have the honor to transmit herewith the manuscript of a report entitled "Know Alabama! The Geology and Mineral Resources of Alabama, a Bibliography for Schools," by Ellen Hildreth and Pauline McCandless Foster. It is requested that this be printed as Bulletin 51 of the Geological Survey of Alabama.

Respectfully,

STEWART J. LLOYD,

Assistant State Geologist

1876
1877
1878
1879

THE HISTORY OF THE

REPUBLIC OF THE

UNITED STATES

OF AMERICA

FROM 1776 TO 1876

1876

THIS pamphlet dealing with the geology of Alabama is followed by a list of materials which may be secured free or at low cost. It has been prepared to aid teachers in meeting the increased interest in Alabama's geology, mineral resources and mineral industries.

Each year classes visit the exhibits of the Geological Survey of Alabama displayed in the Alabama Museum of Natural History in Smith Hall at the University of Alabama. These exhibits are in the fields of geology, mineralogy, paleontology, industry, archaeology and biology. The Museum thus serves the schools of Alabama as a splendid visual aid in studying Alabama's mineral resources. In order to make the trip to the Museum of permanent value, teachers have felt the need for printed materials on these subjects to prepare their pupils for the visit and to use afterward for the interests created. This pamphlet and the list of publications can be used, however, independently of a museum visit.

ACKNOWLEDGMENTS

The authors wish to acknowledge their indebtedness to Dr. T. G. Andrews, Associate Professor of Geology, University of Alabama; Dr. R. M. Harper, Geological Survey of Alabama; Dr. Edgar Bowles, Geological Survey of Alabama; Miss Fannie Schmitt, Librarian, Tuscaloosa Senior High School, and to Mr. Franklin J. Foster, Instructor in Economics, University of Alabama, for reading the manuscript and making valuable suggestions. The pamphlet contains general statements, and the information is taken from material in the bibliography without any other acknowledgments.

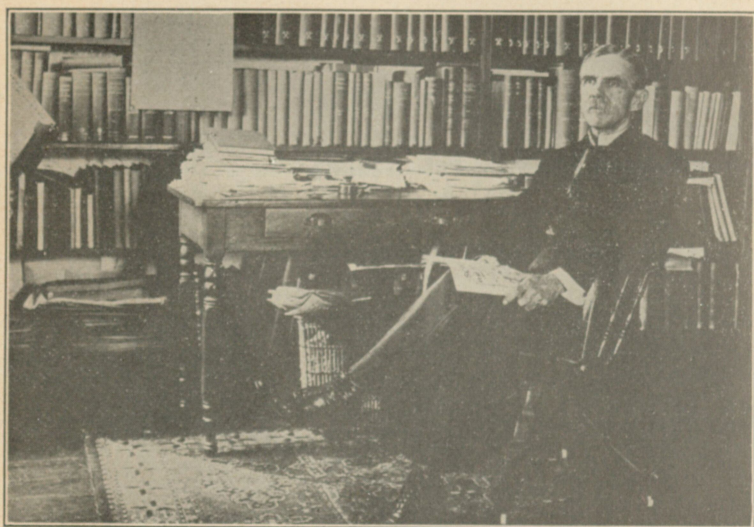


Plate 1

Eugene Allen Smith, in his home—(Photo, R. S. Hodges, September, 1908). (From Geol. Surv. Ala. Bull. 42)



Plate 2

Camp of Eugene A. Smith (seated in center) and Henry McCalley, near the famous Montevallo Mines in the Cahaba Coal Field, in 1883. This wagon, built in April, 1873, is still in possession of the Survey and is in good working order. (From Geol. Surv. Ala. Bull. 42)

THE GEOLOGY AND MINERAL RESOURCES OF ALABAMA

In the science of geology, Alabama for many reasons has an important place. Within this state are representative rocks of many geological eras, periods and formations, and a very important unique arrangement of minerals (iron, coal, and limestone in one valley). In 1833 Mr. T. A. Conrad visited Claiborne, Ala., and found a deposit of fossils in which were many new species. Claiborne is a famous place for collecting by paleontologists and is visited today by many scientists from all over the world. As early as 1848 Professor Tuomey, of the University of Alabama, was appointed State Geologist and authorized to make reports of his geological surveys and explorations and his examinations of the mineral and other resources of the state. As a direct result of Tuomey's account of gold bearing rocks, gold mining was developed. This mining was not important enough to compete with the California gold rush of 1849, and gold mining in Alabama has never since been a real industry in the state. In 1873, Dr. Eugene Allen Smith was appointed State Geologist. Dr. Smith and his assistants published many reports on the geology and mineral resources of the State. Before the turn of the century, iron and coal were recognized as important assets of the state and the new city of Birmingham was established.

GEOLOGY

Geology is a science that uses many other kinds of scientific knowledge in its work; astronomy, to show the origin of the earth; chemistry, to identify the mineral resources; biology and anthropology, to trace the story of life in the world. This diagram will show the interrela-

tionship, and you can develop each section so that you see some definite influence on your own life.

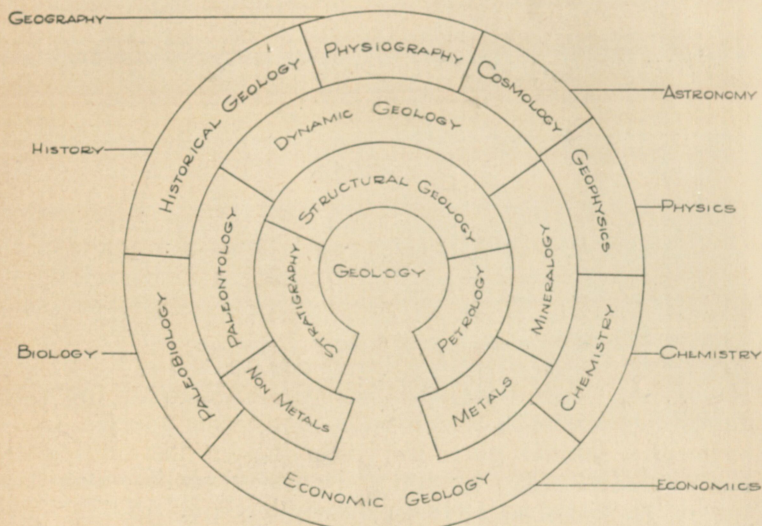


Fig. 1
(Diagram from geological exhibit of the
Alabama Museum of Natural History)

Physical geology, or geography, is the study of the work of the wind, water, and air in changing our earth. These changes affect us in many ways, our climate, soil, water supply and minerals. In Alabama there are many evidences of the past work of these agencies of change: our mountains with iron and limestone deposits, our valleys and coastal plains. In the national parks of the western states are the geysers, volcanic peaks, waterfalls, glacial lakes, petrified forests and canyons. The Grand Canyon is a real book of geology. Here as nowhere else are revealed the methods which nature employs in the alternating processes of building up land structures and of tearing them down only to reconstruct and redomolish them. Here in the sheer walls are to be found fossils of life hundreds of millions of years old. Rocks of various kinds and ages are exposed showing rock structures such as folds, faults, and joints.

The land surface of the earth is composed of layers of rocks arranged in order of their age with the youngest (now still in the making) usually on the top and the oldest below. The study of the rock layers and the mountains reveals great cycles in the history of the earth, and the study of the fossils found in the rock layers reveals that the development of life has proceeded in cycles which kept pace with the geological changes.

The geologist, by reading the records in the rocks, the record of geological and biological development, has reconstructed the past history of the earth and arranged it into a great geological time-table. The time-table is not entirely complete, for here and there gaps exist in the record. In addition, the beginning of the record is missing, for nowhere on the earth's surface does the geologist find rock layers which he feels justified in considering the original surface of the earth. The workings of the forces of erosion, volcanic outpourings and great changes when mountains were pushed into existence, have everywhere obliterated all traces of those early rocks.

The geological time-table is divided into sections known as "eras." These in turn are divided into smaller parts called "periods." These divisions are made on the basis of changes in the record in the rocks. A new period is said to begin where great changes in the nature of the rock layers and their fossils occur. An era is said to end and a new era to begin at those times when the earth goes through a major readjustment and when, as a result, the continents are the highest and largest. At such times, land areas which have emerged from the shallow seas alter ocean currents. High mountains cause winds to lose their moisture. As a result, the climate is cold and dry. Living conditions become hard and a critical period ensues in which dominant types of life perish because they are too specialized to meet the changed conditions, while other types of life begin to take their places.

The record is not an easy one to read. A part of it is to be found in one part of the earth, a second in another locality, a third in yet another and so on. The work of piecing the record together has been slow and difficult and many geologists in all parts of the world have devoted their lives to it. The record of life is found in the

fossils in the rock layers. "Fossils" are the remains of organisms which once lived. Fossils range from the imprint of a leaf or a footprint in a sandstone or shale to an entire plant or animal. As a rule, a fossil consists of the hard parts, such as the skeleton or the external shell of an animal. Usually, as a result of chemical action, the organic parts of fossils have been dissolved and replaced by various minerals. Sometimes, the entire fossil has been dissolved away, so that there is a hole in the rock which is a mold of the fossil form. At other times, such molds are filled with mineral matter, giving a cast of the original fossil.

The fossil records are remarkably complete in some respects, but they are nevertheless marred by many gaps. Fossils form only under certain conditions; and most animals and plants are not preserved as fossils until life has developed to the point where organisms have hard shells or skeletons. The early part of the fossil record, therefore, is particularly weak.

The last billion years covered by the geological timetable, is known as "Geologic Time." Geologic Time is divided into five eras: the Archeozoic, Proterozoic, Paleozoic, Mesozoic and Cenozoic. These names are not as formidable as they appear. Each one, it will be noted, ends in "zoic," from the Greek word meaning "life." The prefixes are also derived from the Greek. "Archeo," "Protero," and "Paleo" are from Greek words which mean "early" or "ancient." "Meso" means "middle" and "Ceno" means "recent."

The fossil record of the Archeozoic and Proterozoic Eras is scanty. These were times of building, of great upheavals and of glaciation. Then the oldest rocks were formed and in Eastern Alabama some of the schist and granite belong in these eras. In the Proterozoic Era there was probably an abundant and varied form of sea life, but since no fossils are found it is assumed that the stage of hard shells or skeletons was not reached. The iron ore beds of the Lake Superior region, the deposits of silver in Ontario, and of copper in Northern Michigan were laid down in the rocks of this period.

In the Paleozoic Era most of the rocks, mountains and valleys of the Birmingham district and Northern Alabama were formed. This era is divided into seven periods,

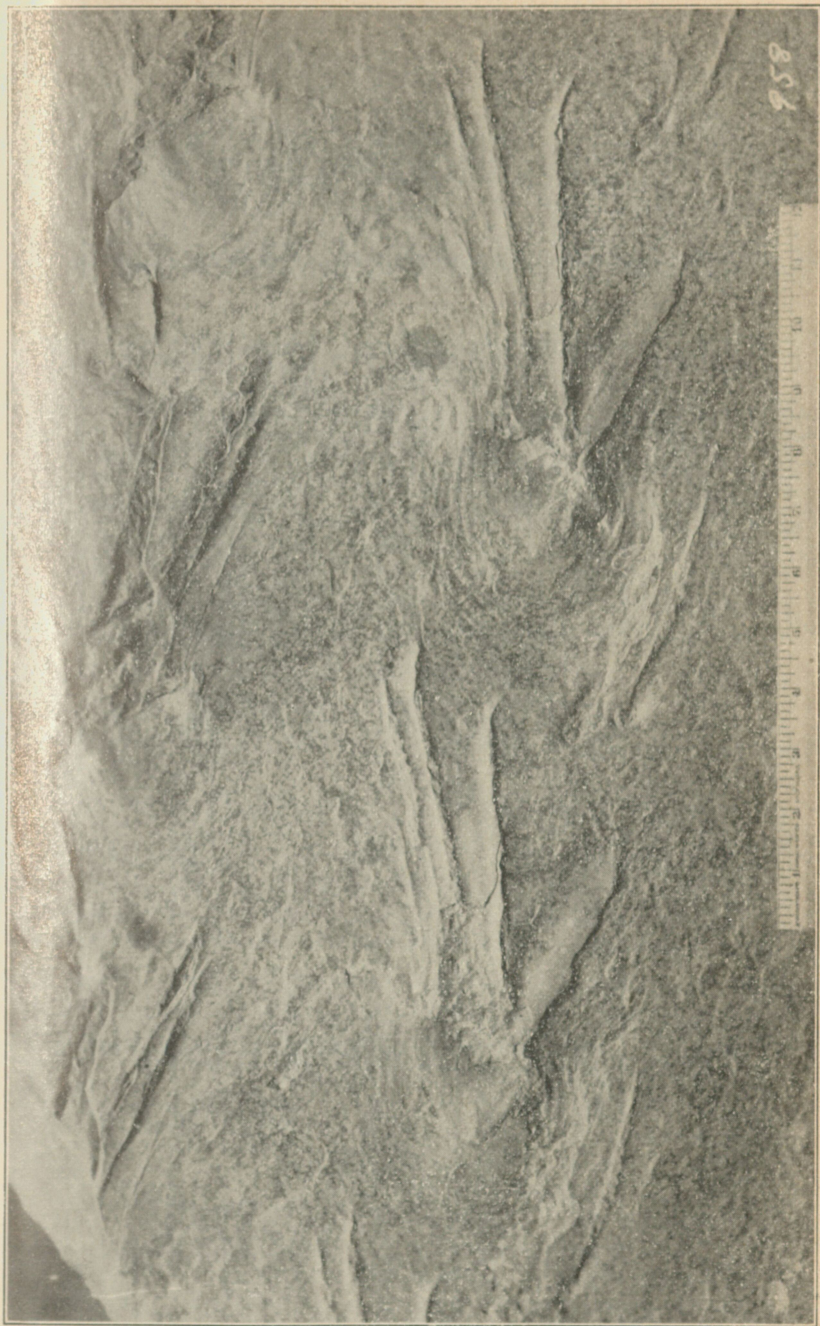


Plate 3

Footprints of a pre-historic animal (*Attenosaurus subulensis*) found in a coal mine near Carbon Hill. This photograph shows that the animal had a large foot and was rather heavy. The front feet are smaller than the hind feet and apparently receive only a small amount of weight. There are some slight traces of a tail between the rows of the casts. (From Geol. Surv. Ala. Museum Paper 9)

known as the Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, and Permian. The rocks of this era are usually highly fossiliferous and the geologist can thus trace the development of life from the trilobite and other forms of oceanic life of the Cambrian, Ordovician and Silurian periods to the first vertebrate fish of the Devonian period and to the insects and amphibians of the later periods. During the first and second periods the quartzite in Shelby and Talladega Counties and the limestone, shale and dolomite rocks of North Alabama were laid down. The red iron ore formation extending from New York to Alabama was formed in the Silurian period. Plant life began in the Devonian period and there is evidence of air-breathing spiders and cockroaches. The Mississippian period is represented in Alabama by the shale, sandstone and limestone found mostly in the north-western part of the state. The oolitic limestone or Rockwood stone belongs to this period. The Pennsylvanian period is important because coal was formed during it. Not only were the seas and fresh waters fully inhabited but the lands were peopled with plants, snails and insects. The climate was warm and moist with an abundant and well distributed rainfall. The seas moved back and forth over the low lands and as a consequence there developed great swamp areas with a varied and quickly growing plant life. The plants were buried in the swamps under later layers of sand and mud and transformed by pressure and heat into great coal beds. At the end of this era occurred a great upheaval of the Paleozoic rocks from Canada to the Gulf of Mexico forming among other things the Appalachian Mountains.

The dinosaurs lived in the next era (Mesozoic). The Brontosaurus and other large reptiles are familiar to us because of their use in advertisements by the Sinclair Oil Company and the models shown at large fairs. But not all dinosaurs were 100 feet long; many were small. Near Eutaw, Alabama, there is a formation of this era which contains the fossil bones of mosasaurs and other giant marine animals. In 1933 Mr. J. J. Renger made some excavations in Greene County and found a giant marine Protostegea turtle and a large Mosasaurus about 35 feet long. Mr. Herndon Dowling, a University student, excavated a mosasaur fossil from this county in the spring of 1941. The specimen is about ten feet long and is probably the re-



Plate 4

Herndon Dowling at the place near Eutaw where he found the mosasaur (1941). (Photo, courtesy of Herndon Dowling)

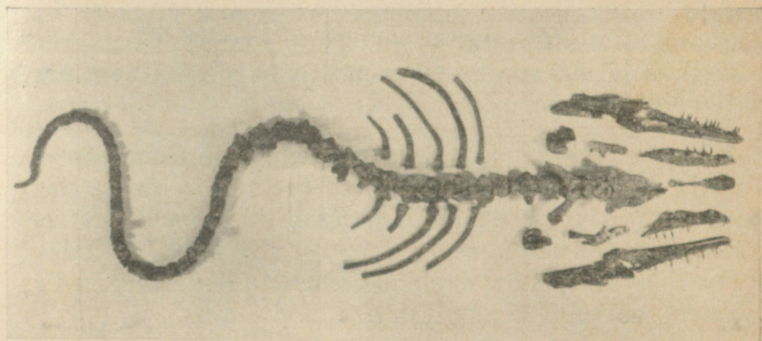


Plate 5

Skeleton of mosasaur found near Eutaw (1941). This skeleton is now on exhibit in the Alabama Museum of Natural History in Smith Hall, University, Ala. (Photo, courtesy Herndon Dowling)

mains of a young reptile as shown by the fact that there are only twelve teeth on each jaw instead of the usual sixteen to eighteen.

The Cenozoic Era, sometimes called the Age of Mammals, was the time of modernization. It was during this period that modern types of vegetation such as ginkgo and magnolia made their appearance on the earth. Shallow seas flooded the margins of the Atlantic coast and the Gulf of Mexico. On the Alabama River the Claiborne fossil beds already mentioned were formed. This world-famous deposit has furnished many new species of marine life of the early Cenozoic Era. Today one can still collect fossils there with a possibility of finding a species never seen before. Toward the end of the era occurred the Great Ice Age during which enormous amounts of material were deposited by glaciers over northern North America, forming many of the plains and lakes seen there today. The glaciers also made basins in which water collected to form more lakes and they are in part responsible for the shapes of the Great Lakes. In the Recent period of the Cenozoic Era man appeared and became the dominant creature on the earth.

The Cenozoic era is represented in Alabama by formations of all the epochs into which it is customarily divided—the Eocene, Oligocene, Miocene, Pliocene, Pleistocene and Recent epochs. All the Cenozoic formations except certain comparatively young river terrace deposits are confined to the Coastal Plain. They occupy an area of more than 17,000 square miles mostly in the southern part of the state.

Most of the deposits formed during the Cenozoic era were laid down on the bottom of the sea as sand, clay, mud, or calcareous ooze, and many of them inclose different kinds of sea shells, sea urchins, or other marine fossils. A few, however, show evidence of having been formed in swamps, marshes, lagoons, or on flood plains.

The surface of the earth is made up of three types of rocks: igneous, sedimentary, and metamorphic. By rock is meant any material that makes up an essential part of the earth. Thus mud, sand, coal or marble are all classed as rocks. Rocks are composed of minerals which are inor-

ganic compounds possessing fixed physical characteristics and almost fixed chemical compositions.

The original igneous rocks were formed by molten lava becoming cool and solid during the formation of the earth into the globe and today the lava from volcanoes is still forming new igneous rock. At first the entire surface of the earth was igneous rock, but geologic processes have since formed other kinds of rocks. Some igneous rocks are pegmatite, basalt, pumice and granite. In Alabama igneous rocks are found in the eastern central section of the state. Some of the minerals in igneous rocks are: orthoclase, quartz and mica.

The second type is sedimentary rock, which usually occurs in layers or strata. These layers were formed by the action of air, water and wind on other rocks causing them to disintegrate and decay and then depositing the fragments in new beds. The greater part of the land surface of the earth is covered with sedimentary rocks. Sedimentary rocks of Alabama are chiefly shale, sandstone, limestone, chert and coal. Among the minerals in sedimentary rock are calcite, quartz, dolomite, limonite and hematite.

The third type is metamorphic rock. Igneous or sedimentary rocks altered by heat, or pressure, or both produce metamorphic rocks. By metamorphism the igneous rock granite is changed to gneiss and the sedimentary rock limestone is made into marble. Both of these rocks are found in Alabama, chiefly in the following counties: Coosa, Tallapoosa, Lee, Clay, Randolph and Cleburne. Some of the minerals in metamorphic rocks are: calcite, garnet, graphite, quartz and talc.

Minerals have different characteristics which make an interesting study called mineralogy. They are classified according to their crystal forms or their chemical compositions. Some minerals such as talc are flexible; mica is elastic, while silver is malleable. Naturally these characteristics influence the commercial use and value of the minerals. Diamonds are not just a precious stone, but on account of their physical characteristic of hardness they are important in grinding other hard materials. At the marble quarries near Sylacauga diamond saws are used to cut the large blocks of stone.

MINERAL RESOURCES

Alabama has deposits of many important rocks and minerals, but in many instances the cost of mining and transporting the small amount of ore is not justified.

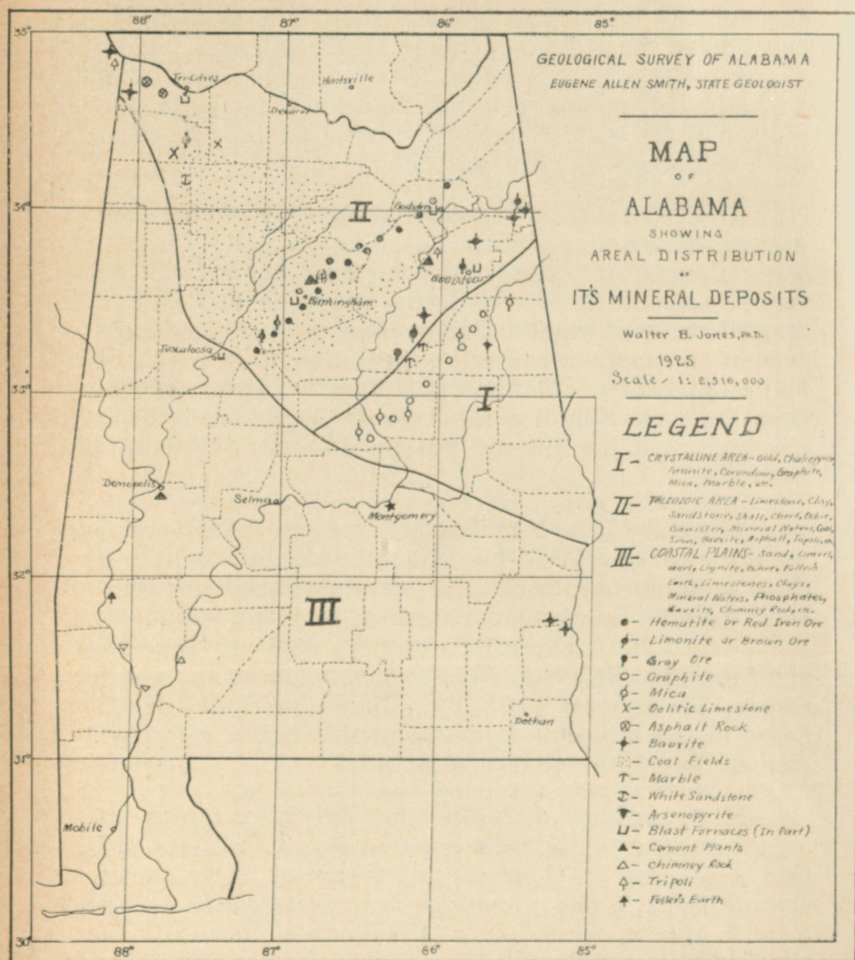


Plate 6 (From Geol. Surv. Ala. Bull. 28)

Fuller's earth is a porous clay which can absorb grease, organic matter, basic coloring matter and other

impurities from animal, vegetable and mineral oils. It is used principally as a filtering medium in the clarifying or bleaching of fats, greases, and mineral and vegetable oils. Its original use was in the fulling of cloth, from which it derived its name. This use, however, at least in this country, has almost been abandoned. Fuller's earth is also said to be used in the manufacture of pigments for printing wall paper, in detecting certain coloring matter in some food products, as a substitute for talcum powder, and in medicine as a poultice and as an antidote for alkaloid poisons. Another suggested use is in delining hides in the manufacture of leather. It has also been stated that the fuller's earth cake from oil mills can be used in the manufacture of hard soaps, concrete, water-proofing and asphalt preparations. Fuller's earth is found chiefly in DeKalb and Clarke counties. Production on a small scale has been carried on from time to time.

Ocher is one of the most widely distributed and easily accessible coloring materials, and for these reasons it has been used since ancient times for personal adornment as well as for economic purposes. The American Indians used this mineral extensively in painting themselves for war and tribal ceremonies. The original Indian red pigment was a natural argillaceous ocher from the Island of Ormuz in the Persian Gulf. Ocher may be defined as the clayey and unconsolidated form of the minerals limonite and hematite (brown and red iron ore) always with more or less impurities consisting primarily of other metallic oxides, clay and silica, hematite (red iron ore) produces the red ocher, while limonite (brown iron ore) yields the yellow, orange and brown varieties. When pure, these minerals contain 59.8 and 70 per cent of iron respectively. The best varieties of yellow ocher range in shade from lemon yellow to golden yellow, and among the red shades those with a purplish cast are more valuable. Ocher is used primarily as a pigment and as a mineral filler, also as a filler and coloring material in the manufacture of linoleum, oilcloth and wall paper. Ocher is also used in the manufacture of protective paints for the exterior of buildings, bridges, roofs, railway cars and the like. Talladega, Calhoun, Colbert and Cherokee counties have deposits of limonite and bauxite which carry excellent yellow and red ochers that might be mined and marketed along with the iron and aluminum ores. Yel-

low ocher has been mined and sold from Autauga and Elmore counties, and excellent deposits are known in Colbert, Clarke and Marion counties. The chief interest in the ochers of Alabama has usually been shown by people of limited capital, who desire to develop certain deposits and produce the ocher on a rather small scale.

Two strategic materials, manganese and mica, have been produced in Alabama in small quantities. Manganese is an absolute necessity in the steel industry where it is used as a de-oxidizer and a de-sulfurizer to produce sound, clean metal. Manganese ore in Alabama occurs usually with limonite and is very low in manganese. Deposits of ore are known in Cleburne, Cherokee, Calhoun, Blount and Etowah counties, but none has ever been developed to any important extent on account of the grade of ore and low per cent of manganese and 'spotty' character of the deposits. Today surveys and experiments are being made on these deposits of ores to try to make them more profitable.

Mica has a number of very useful properties, which particularly adapt it to use in a large variety of industries. The most important of these properties are its perfect cleavage, parallel to the basal plane; flexibility and elasticity; toughness; non-conductivity of heat and electricity; transparency, infusibility and marked resistance to sudden changes of temperature; and the great difficulty with which it decomposes under ordinary conditions of weathering. The principal uses of mica are: electrical insulation in dynamos, telephones, light sockets, spark plugs and other electrical appliances, heat insulation in optical lanterns and in electrical heating devices, glazing in front of stoves and furnace sight holes, compass covers and military lantern slides. The mica industry in Alabama has been characterized by a sporadic development. Most of the early production came from near Micaville in Cleburne County and from the Pinetucky mine in Randolph County. Clay and Coosa counties also have mica deposits. In Alabama the mines are located in an agricultural district, and the mining is done by farmers in seasons when not tending crops. India furnishes most of the mica for the manufacturer today.

Few industries in Alabama have had the ups and downs of the graphite industry. The period of greatest

prosperity was caused by World War I. Thirty plants produced over half of the crystalline graphite reported from the United States with an annual value of almost \$1,000,000. Graphite (also known as black lead or plumbago) is a crystalline form of carbon which has a wide distribution in igneous and metamorphic rocks. Its chief use is the manufacture of crucibles, but it is also used for lead in pencils and as a lubricant. The deposits that have been worked are located in Clay, Coosa and Chilton counties.

Some of our asphalt streets and roads are made from asphaltic limestone found in the northwest counties of Alabama (Morgan, Lawrence, Colbert and Franklin). The tar springs of this section are an indication of the asphalt rocks which really represent the residue left by evaporation of crude petroleum which was at one time part of the deposits.

Bauxite is the most important source of the metal aluminum. It is also used for the manufacture of aluminum salts and other chemical purposes. Most of the Alabama bauxites are too high in silica, and for this reason the ore is seldom used. There are now two large aluminum plants (Mobile and Sheffield) in the state, but they import most of their ore from other states and countries. Three main deposits of bauxite are found in this state: Cherokee, Calhoun and Talladega counties; another in Colbert County; and the third in Barbour and Henry counties in the southeast.

Alabama possesses several extensive formations of limestone suitable for the manufacture of portland cement, and deposits of shale, clay, sandstone, and sand are even more common. Bituminous coal suitable for kiln fuel is mined in the Warrior and Cahaba coal fields within a very few miles of most of the cement plants, and a natural gas pipe line from Louisiana crosses the principal industrial area of the state. Electric power lines also serve most, if not all, of the cement plants. The raw materials of suitable chemical composition must first be mixed in proper proportions, dried, finely ground and burned at a high temperature until they unite chemically and physically as a clinkered mass. The clinker must be ground very finely, usually with additions of small quantities of unburned material such as gypsum to act as a retarder,

and puzzolanic material for resistance to alkalies, sea water, etc. The result of this process is portland cement.

The following cement companies operate mills in Alabama: National Cement Company mill at Ragland, Universal Atlas Portland Cement Company with plant at Leeds, Lehigh Portland Cement Company at Tarrant City, Lone Star Cement Company with plants in Birmingham and Spocari, Alpha Portland Cement Company with plant at Phoenixville. Two companies, Southern Cement Company, Birmingham, and Cheney Lime and Cement Company, Allgood, manufacture a non-portland cement called puzzolan cement.

The portland cement plants in Alabama represent an investment of between \$20,000,000 and \$25,000,000 and produce approximately 5,047,000 barrels a year valued at \$6,800,000.

The chief use for lime produced in Alabama is metallurgical and practically the whole output of the big rotary kilns of the Tennessee Coal, Iron & Railroad Company is used in making steel. A large amount of the lime produced in Shelby and Blount counties is used for building purposes, and a great deal is shipped for metallurgical use. Other important uses are for refractories, paper mills, for chemical uses, and various others.

Clay is one of the most widely distributed of all minerals, and in Alabama can be found clays of nearly every variety. Most clays fall into four groups: ball clays, pottery clays, brick clays and fire clays. The clays that do not contain iron burn white or nearly white at moderate temperature and are used in the manufacture of porcelain. The tests for high grade clay are expensive and complicated and even in the same deposit the grade will differ. Alabama has high grade clays, but as yet they have not been developed for china manufacturing. There are many local pottery producers in the state that use an intermediate grade of clay which burns well and keeps a uniform color.

Brick clay used in the manufacture of brick, terra cotta, sewer and drain tile is the most widely distributed of all the clays, since the requirements are not so strict. Essential features of brick clay are plasticity and color after burning. The general distribution of plants making common and face brick, scattered over many counties of

the state, shows that there are plenty of these clays to supply the demand. The coloring matter for the common red building tile and brick is mostly iron oxide, while the absence of this constituent gives a buff to almost white color. The soils which are formed through the disintegration of limestones are usually charged with iron oxide and make a good complex for common brick and its allied products. Such clays are abundant in northeastern Alabama. These ferruginous clays can be burned to a hard product more safely than the ores which give a lighter color.

Clays for common brick should not be too sandy, for the product must be porous. Uniformity in color is not a consideration, the only requirement being that of sufficient strength to withstand the load placed upon it. The requirements for face brick are that the product be absolutely uniform in color and possess a hard body. The beauty of the structure naturally depends upon the color of the brick and its blend with the surroundings. In no branch of the clay working industry is the range of colors which can be produced from natural clay mixtures more carefully considered than in the manufacture of pressed brick. Face brick should also shrink evenly in burning, in order to obtain an even and straight outline.

The Rockwood limestone of the Russellville district was first surveyed by Michael Tuomey in 1857. His report aroused popular interest and, as a result, T. L. Fossick prospected the entire area of the district and finally opened extensive quarries near Rockwood, Alabama; from this town the stone derived its name. A modern finishing mill was erected and equipped with gang-saws. The grade of limestone grew steadily in popularity among builders who were acquainted with its qualities. Gradually facilities at the quarries were increased to meet an ever-mounting demand until finally the properties were incorporated under the name of the Rockwood Alabama Stone Company. From that time the stone came to the attention of more and more architects and was used in an ever-increasing radius.

The Rockwood stone is almost pure oolitic limestone whose nature makes it especially good as a building material. It can be procured in all colors from the clear,

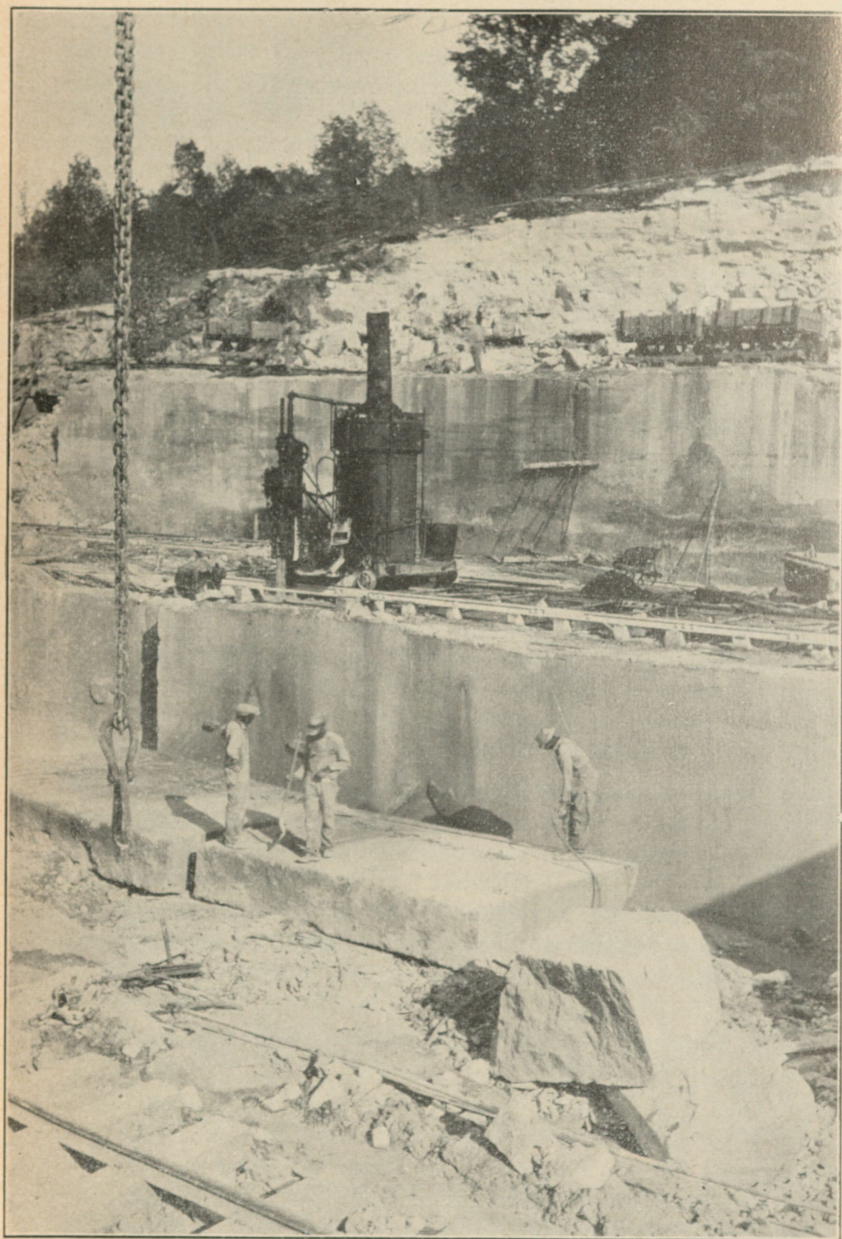


Plate 7

Quarry at Rockwood, showing the stripping at the top, and the working floors. The ledge in the foreground has just been pulled down and is being worked into the desired blocks.

(From Geol. Surv. Ala. Cir. 8)

beautiful white through all variations to the bluish and grayish shades. The markings are always uniform and it takes a beautiful finish. The Alabama Power Company Building, Birmingham; Union Building, University of Alabama, and the Animal Husbandry Building at Auburn are some examples of the use of this stone in Alabama. The stone was also used in the construction of the Louisiana State Capitol, the Metropolitan Life Insurance Building in New York and in many churches, schools and other important buildings in this country.

The other important building stone in Alabama is marble which occurs in a narrow belt along the border of the metamorphic area, extending from Marble Valley in Coosa County through Talladega into Calhoun. The belt is about 35 miles long and only one and one-half miles wide at its widest point, near Sylacauga, and is usually only one-half mile wide. Several openings have been made in this belt, but the bulk of the production has come from the quarries located around Sylacauga, in Talladega County.

The color of the marble ranges from almost pure white to cream with various grades of streaked or clouded varieties, all of which are very beautiful. The stone takes a high and brilliant polish, a property that distinguishes marble from limestone. Most of the crushed material and refuse from pits is used for various purposes, such as furnace flux, agricultural lime, terrazzo (for floors) and the like. In addition to its use as a building material Alabama marble is also used for statuary work.

"Millions of years ago nature stored away billions of tons of coal for us, and then left a record of her processes written in a language that all ages and tongues can understand. It is a story so wonderful as almost to defy belief, and yet one so plain to him who reads it as to defy unbelief."

In the underlying and overlying strata of the coal seams may be seen petrified stumps and roots. With this evidence, can it be doubted that trees grew in the coal-forming age? And when you find petrified ferns and other carboniferous fossils above and below the coal, and the evidences of them in the coal when placed under a



Plate 8

The "Head of Christ" by G. Moretti, was the first notable piece of sculpture ever made in cream-white Alabama marble. It was exhibited at the St. Louis Exposition, where it was awarded a silver medal. The "Head" was greatly admired both for its artistic worth and the beauty of the marble in which it was wrought.

(From Geol. Surv. Ala. Bull. 18)

powerful microscope, can you doubt that plants were existent on the earth in that era?

How amazingly dense was the vegetation of the coal-forming era may be shown by comparison with existing forests. Should nature, by the processes of the coal age transform the densest jungle on earth today, into a coal seam, it would be only a few inches thick.

In this phase of the earth's history, nature was generous to Alabama, having deposited within her borders many billion tons of coal. Although over a half billion tons have been extracted during the past century, there remains, still unmined in the state, according to estimates of the U. S. Geological Survey, sufficient reserves of commercially workable coal to last, at the normal rate of consumption, several hundreds and probably thousands of years.

These coal deposits are divided into the following fields:

The Warrior Field, located north and west of Birmingham, comprises parts of Jefferson, Blount, Cullman, Winston, Marion, Fayette and Tuscaloosa counties and the entire area of Walker County. Its known area is about 3,000 square miles and it yields nearly all of our coking coal and large quantities of domestic and steam coals.

The Cahaba Field, lying southeast of the Warrior Field, is located in St. Clair, Bibb, Shelby and Jefferson counties and contains an area of approximately 400 square miles. It produces domestic and steam coals.

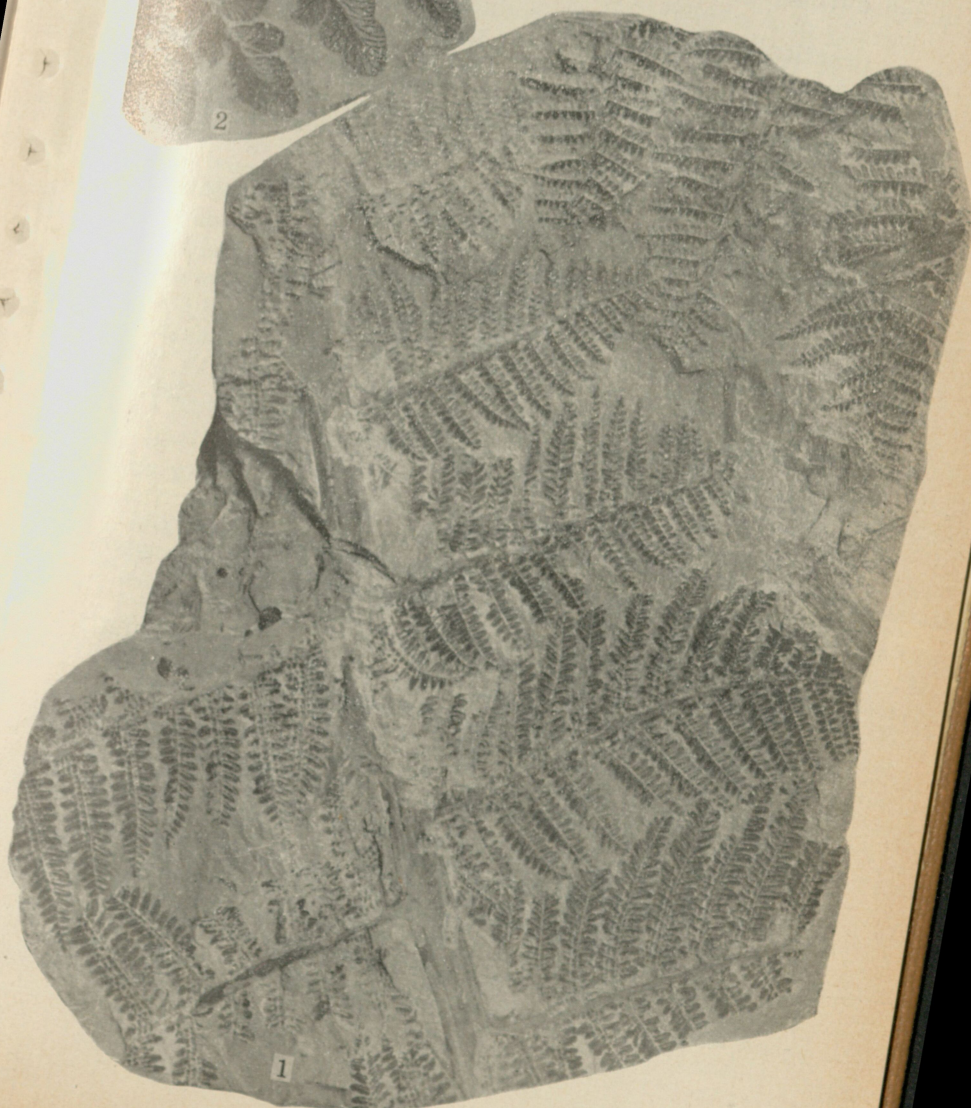
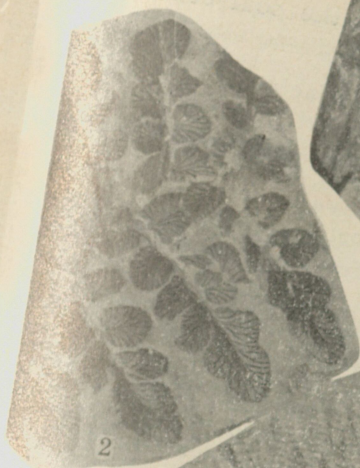
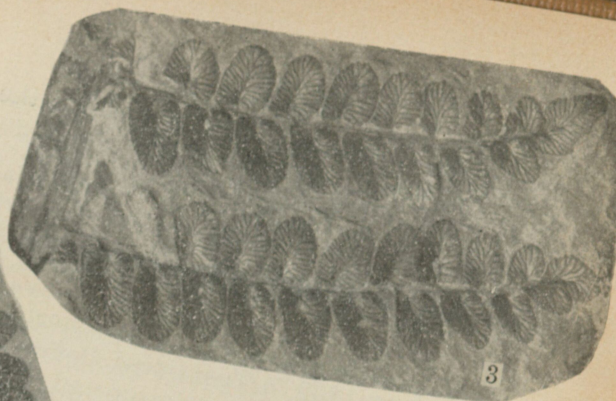
The Coosa Field lies mainly in Shelby and St. Clair counties and comprises an estimated area of 340 square miles, but is practically undeveloped.

This generosity of nature is tempered by natural conditions unfavorable for mining. Owing to the fact that many of the seams from which the coal must be mined in Alabama are thin and pitching and broken up by faults, the recovery of the coal therefrom is difficult and expensive. Furthermore, practically all of these seams have one or more partings of rock and many of them have "draw slate" and bone coal on top and clay or soft "shale" floor, which becomes mixed with the coal in mining. The presence of these impurities necessitates a costly

Plate 9 (opposite page)

Fossil plant (*Neuropteris smithii*) from the Black Creek coal bed, Warrior, Jefferson County. This plant is named after Dr. Eugene A. Smith, State Geologist of Alabama from 1873-1927.

(From Geol. Surv. Ala. Special Report 14)



process of cleaning and washing after the coal comes from the mine.

Coal mining, together with the manufacture of coke, iron and steel, has played a prominent part in the industrial history of Alabama.

According to the best information available, the first coal produced in Alabama for commercial purposes was mined during 1830 in Tuscaloosa County near where the University of Alabama is now located. For the next thirty years practically all the coal produced in the State was dug from seams outcropping near the river or from the river beds and shipped by boat during flood season to Mobile. During that period, development had begun in other counties. In the year 1850, it is recorded that two hundred men were engaged in the coal mines located near Montevallo in Shelby County.

Shipment of coal by rail began from these mines during 1856, and, as additional railroads were constructed and put in operation throughout the coal fields, providing means of transportation for the product to market, the number of mines increased. Although the difficulties and obstacles of financing, operating, and marketing the output have been many and great, the growth of the coal and coke industry progressed rapidly, as, also, did the production of iron and steel, in the State.

However, one of the principal factors in causing an awakening of the nation, especially the South, to the value and possibilities of the mineral resources of Alabama, was the production of coal and iron ore in the State during the Civil War.

The first coke was made from Alabama coal in 1855 and on February 28, 1876, it was demonstrated at the Oxmoor Furnace, in Jefferson County, that iron could be made with coke. (Prior to this time, all Alabama pig iron had been made with charcoal). This discovery greatly stimulated coal and coke production.

Prior to 1898 when the first by-product coking plant was built at Ensley, all coke was produced in bee-hive ovens, but the by-product ovens gradually supplanted the bee-hive type, and by 1928 all the bee-hive ovens had been abandoned, though some are now in use again.

Coke, formerly produced almost entirely for blast furnace use, became a factor in the domestic fuel market in 1920.

Alabama coal, all of which is bituminous, is produced from 31 seams of various grades, each having different characteristics, and adaptable to many uses. It is prepared in various sizes and grades to meet customer requirements, the principal uses being for open grates, stoves, stationary boilers including steamships, railroad locomotives, blacksmithing, all types of heating plants, whether fired by hand, mechanical stokers or pulverizers, also for making gas and coke.

The Annual Report of the Alabama Department of Industrial Relations for the fiscal year ending September 30, 1941, shows 14,535,316 tons of coal produced by mines with railroad connections, and 948,564 tons by "truck mines" (formerly called wagon mines), a total of 15,483,880 tons. The same report shows 22,885 men employed in and about the mines.

Lignite, sometimes known as brown coal, occurs in important deposits in a narrow and irregular strip of territory about twenty-five miles wide, which extends across the state, including the greater part of Wilcox, Butler and Crenshaw counties, the southern part of Barbour, Pike, Marengo and Sumter counties, and the northern part of Henry, Dale, Coffee, Monroe, Clarke, Choctaw, Covington and Conecuh counties. Lignite is the second product in the transformation of vegetable accumulation into coal. The color varies from yellow to black but is usually dark brown. It has a dull luster, but in some cases may be waxy, due to the presence of earthy impurities. Other minor deposits are known but the beds are usually thin and not very extensive. In a state which has an abundance of bituminous coal it is natural that lignite should receive little attention, since it is very much inferior in heating value and cannot be successfully stored or shipped because of its property of slacking or crumbling upon drying. It will not fuse or cake upon heating, and thus is not suitable for the manufacture of coke.

The future of the Alabama lignite depends upon its utilization for fuel purposes near the occurrence, and at the present time there are no industries in this area requiring large amounts of fuel. Lignite is well suited

called anticlines. When this anticline was formed, the crest of the fold was broken, and water entered the fractures and carried away large portions of the fractured rock—making a valley. The harder, more resistant beds were left behind, and now form the ridges, Red Mountain and Enon Ridge, on either side of the valley. The ridge to the northwest is the basal sandstone of the coal field; the ridge to the southeast is known as Red Mountain, where both iron ore and limestone occur; and in between, on the floor of the valley, is a bed of dolomite, used as a flux in blast furnace operations.

There are three main groups of coal seams: the Pratt Group nearest the surface, the Mary Lee Group 500 feet below, and the Black Creek Group 300 feet below that. Ten workable beds vary from three to six feet in thickness. The Warrior field, in which these seams occur, covers an area of approximately 3,500 square miles. The Pratt Group, which is by far the most important, is further divided into two beds, the Pratt and the America.

All the coal is mined by underground methods. In the vast underground workings of the mines, the coal is under-cut and blasted from the face of the seams and hauled by electric locomotives to shafts where it is hoisted to the surface. But it is not yet ready for use when it emerges into daylight.

The Pratt seam contains two bands of rock, from two to eight inches in thickness, imbedded in the coal. A method of washing the coal in jig washers was developed as a means of eliminating this rock, after the coal had been brought to the surface.

The washed coal is transferred to the coke ovens at Fairfield where it is converted into coke, and the by-products recovered, and from there to the blast furnaces at Fairfield and Ensley.

The iron ore over on the other side of the valley, in Red Mountain, is also mined by underground methods. The mines operated by the T. C. I. Company are located at Muscoda, Wenonah and Ishkooda. The merchantable ore bed averages 10 feet in thickness. It has been estimated that at the present rate of operation these deposits should last for another century.

Inclined slopes are sunk in the side of Red Mountain, some of them going back for a mile or so under the mountain. The ore is blasted out of the seam in the under-

ground rooms, placed in cars by mechanical loaders, and taken by rail to underground tipples where it is dumped down into skip cars on the main slope. The skips are then hauled to the surface tipples where the ore is crushed. It is then loaded into cars which are hauled over the famous "high-line."

This standard gauge railroad from Fairfield to the ore properties on Red Mountain was constructed by the Tennessee Company in 1924. The tracts extend five miles from Fairfield across Opossum and Jones Valleys and through Flint Ridge directly to the Wenonah group of mines. From there they extend to the Muscoda and Ishkooda groups.

The line to Fairfield has become known as the "High-Line" because of its elevation above the valleys and its overhead crossings. The tracks are raised 15 to 20 feet above the valley level, and pass through Flint Ridge with a cut 58 feet deep. Nine bridges carry the line across steam railroad tracks, four electric railway tracks, four highways and one water course. The largest bridge is 800 feet long and crosses five railroad tracks, a private road leading to the Tennessee Company's Fairfield works and a waterway.

One of the most interesting features of the iron mines is the fact that at Muscoda there is a limestone mine which is worked through the slope of an abandoned iron mine. About 300 feet above the ore seam there is a large deposit, from 30 to 40 feet in thickness, of very pure limestone.

The limestone is blasted out in a number of rooms and taken to an underground dump where it is dropped 300 feet through the middle of the mountain to the underlying iron mine slope. From there it is hauled to the tipples and crushers at the surface and from there to the mills over the "high-line." This is one of the few underground limestone mines in this country.

The only open pit operations conducted by the mining department of the Tennessee Company are at the Dolonah dolomite quarry, where the overburden is stripped off, and the dolomite quarried, after which it is crushed, washed and sent to the blast furnaces and open

hearth. About 500,000 tons of dolomite are produced a year.

But the mining and operating men may at times consider this district something other than a Paradise. For the iron ore contains only about 37 per cent iron, and the coal seams are thin and dirty. This makes it necessary to wash every ton of coal mined and to use additional quantities of flux and coke to reduce the ore. It's hard work for those who have to make Paradise pay.

The plants of the T. C. I. Company are located in or near three towns in the immediate vicinity of Birmingham—Fairfield, Ensley and Bessemer.

The coke department of Fairfield Steel Works receives the coal which comes out of the Warrior field to the northwest of Birmingham. Three batteries of by-product coke ovens, a total of 357 ovens, have a capacity of over a million and a half tons of coke a year.

This coke meets the iron ore and limestone from Red Mountain, and dolomite from the Dolonah Quarry at the blast furnace, converter and open-hearth departments at Fairfield and Ensley, where they start the process of being transformed into finished steel products.

Six blast furnaces at Ensley have an annual capacity of 1,121,100 gross tons of pig iron, together with ferromanganese and recarburizing metal used for controlling the chemical composition of open-hearth steel.

The Ensley plant is one of comparatively few in the country, and the only one in the United States Steel organization, where the so-called duplex process is used, a combination of the Bessemer converter and open-hearth methods. The pig iron, coming from the blast furnaces, is charged into the three Bessemer converters, where a stream of air, under great pressure, is blown through it, reducing the carbon, silicon and manganese content of the iron.

This "blown" metal, which still has a high phosphorus content, is then charged into nine basic open-hearth furnaces, where the phosphorus is removed and the steel otherwise refined to the specifications desired. The duplex process is particularly well adapted to the high-phosphorus pig iron yielded by the iron ore of Red

Mountain. It takes only about seven hours to produce a neat of steel by this method, where the ordinary open-hearth process takes ten to twelve hours.

The high-phosphorus slag resulting from this process has proved to be an economical and effective plant food. It is broken up and a magnet is passed over it to remove the small pieces of steel, after which it is ground and screened and packed in 100-pound bags for sale to farmers.

From the open-hearths, the steel passes through a 44-inch blooming mill and a 34-inch billet mill to the rail mill, which has a capacity of 555,000 tons of railroad rails per year. Rails are the only finished steel products turned out at the Ensley Works. However, considerable tonnage of semi-finished steel is produced in the form of billets for the finishing mills at Fairfield Works to supplement the steel made at Fairfield. Some of the finished products of the mills at Fairfield are steel reinforcing bars, hoops and steel bands for cotton bales, fence wire, nails and staples.

ALABAMA

Before the Spaniard and the Gaul
Had touched thy shores, on treasure bent,
Before the Norseman's sturdy sail
Had crossed the sea, with strength unspent,
The dogwood on thy sunny slopes
Had flashed its April screen of snow
Thy turbid rivers through the hills
Had worn their paths to seas below
Beneath the breathless Summer sun
Thy tall pines marked the eagle's flight
And down thy central valley's rim
The blood red iron sought the light.
Breathe on us, Thou who changest not,
The spirit of the early days,
The eager, hopeful, faith in life
The courage born of simple ways.
This is our land, our hopes are here,
Our children follow; give us light
That we may build throughout the years
A people pleasing in Thy sight.

—Stewart J. Lloyd

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Acknowledgment is made to Miss Eva Rimmer, Miss Audrey Taylor, and Miss Faine Terry for their contribution toward the preparation of this bibliography while enrolled as students in Library Science 78 during the Spring of 1941.

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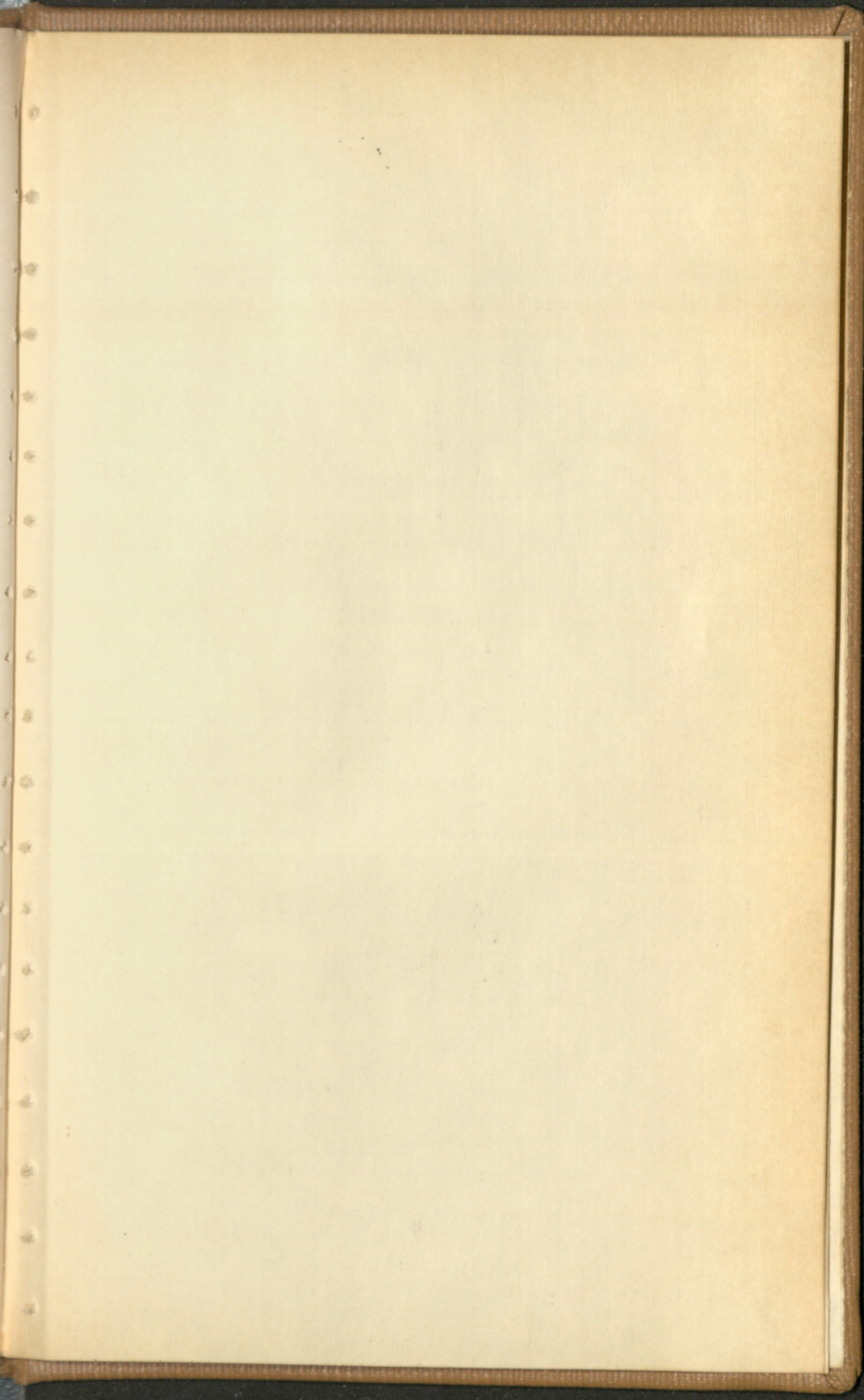
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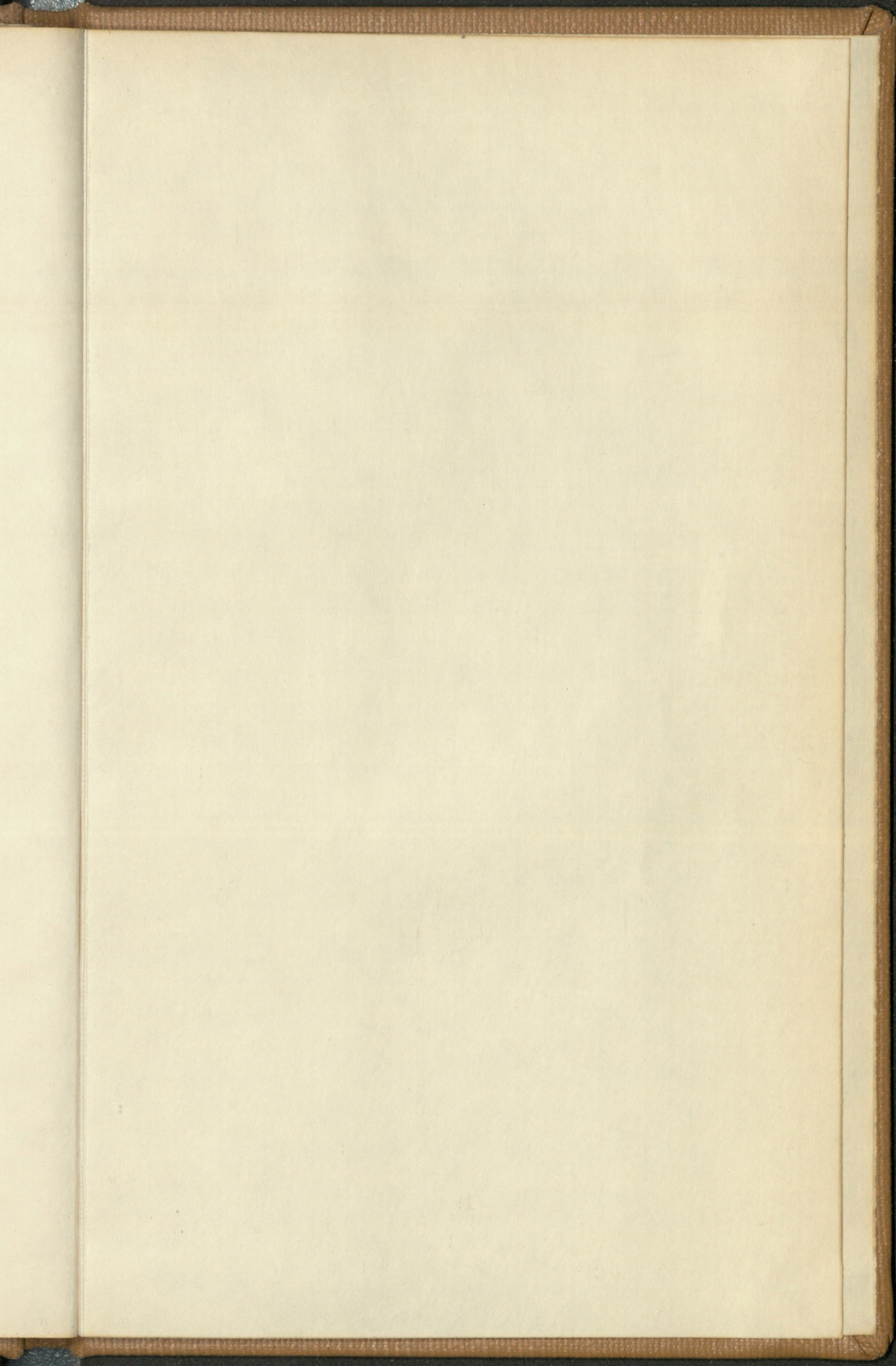
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